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Chemistry: Opportunities and Needs

The report of the Committee for the Survey of Chemistry* (*see* p. 1267, this issue) is a well-conceived, well-edited document that outlines opportunities for research in chemistry and discusses the central role of the science in many types of fundamental research and its relevance to industry, agriculture, medicine, and defense. The report emphasizes that chemistry is in the midst of a great renaissance triggered by development of new instrumentation.

Before 1945, laboratory techniques in organic chemistry were little different from those of 1895; today, electronic equipment of many kinds is an essential adjunct of the chemical laboratory. Modern methods have revolutionized the determination of molecular structure in both organic and inorganic chemistry. The new empirical knowledge, coupled with advances in theory, has permitted synthesis of a host of important substances, such as penicillin, reserpine, and sterols. Many interesting molecules that do not exist in nature have been synthesized, including types that were sought only after their stability had been predicted by theory.

The new instrumentation has been helpful in other areas, such as reaction kinetics. It has been possible to elucidate very fast reactions such as occur in flames. Experiments are being performed that take into account the structure, vibration, and rotation of individual molecules. Modern physical chemists have revitalized the molecular kinetic theory by interpreting experimentally observed reactions occurring in shock waves and in colliding beams and reactions involving excited molecules.

The impact of chemistry on other fields of science has also expanded. Advances in solid-state physics and in many phases of earth science are contingent on chemistry. Research in biology and medicine has become increasingly chemical in nature. A major hope for future medical advance lies in the chemistry laboratory.

The role of applied chemistry has increased. Sales of chemical products total $36 billion a year. In addition, the petroleum industry, which is in fact a great chemical industry, has sales of $42 billion. Nearly every article of commerce is coated, colored, cleaned, protected, stabilized, or otherwise modified by synthetic chemicals. Chemistry in some form enters into perhaps half of our gross national product.

The cornerstone of these tremendous contributions is fundamental research at the universities. These institutions train men needed by industry, but they do more. University laboratories are the source of a large part of the fundamental knowledge that is later exploited by industry. The committee's analysis of a group of papers, published since 1946, announcing about 40 inventions or practical discoveries shows that 60 percent of the literature citations in the announcements were to university-based research.

The renaissance in chemistry has required expanded use of instrumentation. Use of major instruments has increased sixfold during the past 12 years. Nevertheless, the inventory of major equipment in the 125 chemistry departments that grant the Ph.D. degrees totals only $55 million, and much more new equipment is required. However, as needs and opportunities in chemistry have expanded, federal agencies have been slow to respond.

Chemistry is essential to food, clothing, shelter, health, and defense, but these needs are prosaic and have not been able to compete with headline-catching spectaculars for the administrator's or the politician's attention. The new report may correct this. Though conservative in tone and language, the document, through its intellectual excellence, presents a compelling case. If the report is read, it will be implemented.

—PHILIP H. ABELSON

**Chemistry: Opportunities and Needs*, "A Report on Basic Research in U.S. Chemistry by the Committee for the Survey of Chemistry, National Academy of Sciences–National Research Council."